

Aircraft Structures Definitions

A

Access panel

- removable panel for inspection or maintenance

Aft

- rear of in the direction of the rear of the aircraft

Aerodynamics

- the study of how the moving body (aircraft) interacts with air flowing around it, flies

Aerodynamic centre

- the point of application for additional aerodynamic loads

Aeroelasticity

- the study how to find measures against flutter (undamped vibration in the structure due to aerodynamic loads)

Airfoil

- wing-section

Afterburner

- extra injection of fuel in extra combustion chamber between the turbine and the nozzle of the engine; creates a higher thrust

Age hardening, ageing

- strengthening at room temperature of a quenched metal alloy by very small and uniformly dispersed particles that precipitate from supersaturated solution

Ageing

- decrease of mechanical properties of polymer matrix composites or adhesives by exposure to a wet environment

Aileron

- control surface for aircraft rolling

Airframe

- main components which carry all the loads

Aisle

- passage in passenger cabin between rows of chairs

Allowable stress

- maximum stress level allowed in a structure (so that it does not deform plastically or break)

Alloy

- the combination of several metal components

Angle of attack

- the angle between the chord line of a wing or other aerodynamic surface and the oncoming air

Anhedral (negative Dihedral)

- a wing in a reverse v-form

Aspect ratio

- the ratio of wing span to average chord, an indication of the slenderness of a wing

Assembly

- building parts and components together to an aircraft

Auxiliary power unit

- system to generate electric power when the engines are not running

Auxiliary spar

- an extra beam in the root in the wing for extra strength

B

Beam

- a structural member loaded at an angle (often at a right angle) to its length

Bearing stress

- used for bolted or riveted joints – load/bolt diameter times material thickness

Bending moment

- the product of a force and its moment arm

Biplane

- aircraft with an upper and lower wing on top of each other

Bird strike

- an impact of a bird on the structure

Blade

- one half of a propellor

Bolt (nut)

- joining member consisting of head and stem using a nut to tighten it

Bonding or adhesive bonding

- method of joining using adhesive material (polymeric material with sufficient strength to transfer load)

Brace

- strengthening wire to support a structure, generally loaded in tension

Bracket

- small fitting or support to attach system parts

Brake

- system attached to the wheels to slow down or stop the airplane when on the ground

Buckling

- out of plane bending, followed by crushing of material under compressive loads

Bulkhead

- a panel separating areas in the structure

C

Cabin

- the space in the airplane where passengers (payload) stay during the flight

Camber

- the curved line precisely between the upper and lower skin of an airfoil

Canard

- an arrangement of foreplanes and wing, rather than the conventional wing and horizontal tailplane

Cantilever

- a beam supported only at the end

Centre of gravity

- point of balance of the mass of the aircraft (component)

Centre of pressure

- the centroid of the pressure distribution

Centre-line of aircraft

- line connecting geometric middle points of cross sections of the aircraft structure

Centre wingbox

- central part of the wing which is located inside, right under or right above the fuselage

Centrifugal force

- a resulting force by spinning a mass around

Clips and Cleats

- small angles or simple sheet metal parts for (shear) connection of various parts

Chord

- the distance between the leading and trailing edge of a wing section

Chord line

- an imaginary line jointing the leading and trailing edge of a wing section

Cockpit

- place where pilots fly the airplane

Composite

- containing more than one component (in particular materials containing a mixture of plastics and metal, or fibre reinforcements)

Compression

- stress or force that tends to push material together

Compressor

- part of the jet engine where the air coming from the inlet is brought to a higher pressure

Controls

- instruments to control the aircraft: change the position of the control surfaces and the propulsion

Corrosion

- attack of the material by an unwanted chemical reaction (oxidation)

Cowling

- the covers around the engine

Cruising flight, cruise

- the steady, stationary part of the flight when the airplane is not landing starting or performing a manoeuvre

Cut out

- removing of material, opening in skin or structure

D

Deflection

- change of the position of the control surface

Delta wing

- a wing in a triangular planform

Dihedral

- wing in a v-shape

Door

- a hatch for letting people or cargo in and out

Double curvature

- structures that have different curvatures in two directions of various directions

Doubler

- reinforcing sheet against the skin

Downwash

- a small air velocity component in the downward direction aft of the wing

Drag

- a resisting force as a result of the motion of body through a medium

Drain holes

- holes in the structure to remove water accumulated during flight

E

Elastic limit

- point where elastic elongation changes in plastic elongation

Elevator

- control surface for pitch

Elevons

- control surface for pitch and roll

Empennage

- the rear section of the body of the airplane with stabilisers

Engines

- the power units for propulsion of the aircraft

Extrusion

- a forming technique whereby a metal in plastic condition at elevated temperature is force, by pressure, through a orifice

F

Fail safe

- principle of maintaining adequate performance after some degree of damage or degradation has occurred

Failure

- plastic deformation or breaking of a structure

Fairing

- non-structural transition part between components to create an aerodynamic smooth shape and low drag

Fan (ducted – unducted)

- propeller (shield – unshielded)

FAR

- Federal Aviation Regulations, certification procedures and airworthiness standards of the US government (FAA)

Fasteners

- means for mechanically joining parts (bolted and riveted joints)

Fatigue

- failure, at relatively low stress levels, of structures that are subjected of fluctuating and cyclic stress

Fence

- shield

Fin

- vertical stabilizer, tailplane

Finite element method

- numerical method of calculation by discretisation a continuum into a finite number of parts (elements)

Fitting

- generally heavily loaded part or fixture to attach system or other part to a structure

Flap

- the movable part at the trailing edge of the wing which, when extended and / or deflected, increase the lift

Flaperon

- the surface which combines the control function of flaps and ailerons

Flight deck

- place where the pilots fly the airplane

Foreplane

- a horizontal stabilizing and control surface forward of the wing (see canard)

Flutter

- an oscillation caused by interaction between structural and aerodynamic effects

Floor

- lower surface of the cabin

Frame

- a hoop-shaped fuselage member which gives it its cross-sectional shape

Fuselage

- the mainbody of the aircraft, airframe without the wings and the tail

G

Gust

- turbulence

H

Hardness

- the measure of material's resistance to deformations by surface indentation or by abrasion

Hatch

- door for inspection or maintenance

Heat treatment of metals

- treatment to improve the material properties (mechanical properties, formability, corrosion resistance)

High lift device

- device to create higher lift

Hinge

- a movable joint with one (or more) degree(s) of freedom

Honeycomb

- the core material, between face sheets of a sandwich structure, with the shape of the six sided wall shape made by the honeybee

Hooke's law

- the strain is equal to the stress divided by the Young's modulus

Hoop stress

- stress in a pipe wall acting circumferentially (in a plane perpendicular to the longitudinal axis of the pipe) and produced by the pressure of fluid or gas in the pipe

Horizontal stabilizer

- horizontal tailplane

I

ILS

- instrument landing system

Impact

- collision of object onto a structure

Inertia

- a body's resistance to a change in its motion as a result of an applied acceleration

Intake

- the inlet of the engine to decelerate the flow

Intercostal

- part connecting two ribs for attachment of systems

J

JAR

- Joint Aviation Regulations, certification procedures and airworthiness standards of the European Joint Aviation Authorities (JAA)

Joggles

- preformed flange of stringer to fit precisely and follow thickness steps in structure

Joint

- the connection between two parts

L

Landing gear

- the system (wheels, brakes, shock absorbers, struts, etc) on which the airplane can land

Landing loads

- the forces which are caused by landing in the landing gear and back-up structure

Leading edge

- the front of the wing or tail plane

Lift

- a force at right angles to a body's motion through the air, generated as a result of a pressure difference between opposite surfaces

Limit load

- the high force which will be one time load the structure at which no plastic deformation should occur

Load

- the forces and moments acting on a structure

Longeron

- the main stringer in the fuselage or longitudinal beam

Lug

- ear or connecting link

M

Mainframe

- frame at which wing spar is connected to the fuselage

Maintenance

- to keep the plane in good condition for continued operation

Manoeuvre

- movements of the aircraft deviating from the stationary flight (e.g. rolling, banking, turning)

MIL handbook

- military handbook (USA)

Modulus

- elastic modulus (or shear modulus): resistance against deformation of a material (see also Hooke's law), ratio of stress to strain, measure for the material stiffeners

Moment arm

- the perpendicular distance from the line of action of a force to the point at which the moment acts

Monocoque

- a structure with a closed cross-section which mainly consists of a thin skin

Mould

- a form in which you can cast or form a part

Mount

- to fix on a support

N

Nacelle

- outer casing and support structure of an aircraft engine

Notch

- sharp groove or cut in material

Nozzle

- the exhaust end of the engine where the air jet accelerates

P

Paint

- polymeric material used as coating for corrosion protection or for aesthetic reasons

Panel

- structural subassembly of skin and stiffening elements

Payload

- the cargo and people that have to be transported

Pitch

- rotation around the y axis of the aircraft, distance between parts (e.g. rivet pitch)

Plastic

- deformation which will not go back to the original state when the forces will be gone

Plate

- flat piece of material with thickness over 6 mm (see also sheet)

Poisson's ratio

- the negative ratio of lateral and axial strains that results from an applied axial stress in the elastic zone of a material

Precipitation heat treatment

- hardening, by heating the quenched alloy at about 175°C for a few hours, due to very small particles that precipitate from a supersaturated solid solution

Prepreg

- continuous reinforcing fibres (UD or fabric) impregnated with uncured matrix resin to manufacture a composite part

Pressure

- force by gas or liquid acting on a solid surface, depending on flow conditions

Pressurization

- pump more air into the cabin than is allowed to escape

Primary structure

- the parts of the plane in which failure will be causing fatal danger for the passengers

Primer

- first coat of paint or diluted adhesive material

Pylon

- slender compound of structure for attachment of engines

R

Redundancy

- the provision of alternative load paths or functional routes such that the failure of the element will not cause collapse of the entire structure or total system failure

Residual strength

- a strength that remains in a material or part that contains a damage or crack

Resultant of forces

- the sum of the forces acting on a structure

Rib

- part of the wing structure which provides the wing-section's shape and supports the skin and stringers

Rib cap

- part of the rib, flange, that connects to the skin

Rivet

- fastener in sheet metal parts, consisting of head and stem, and after placing an upset head is formed by squeezing or hammering

Rolling

- rotation around the x-axis of the aircraft, due to aileron deflection; deformation of sheet material with a rolling mill in a circular cross-section

Root

- the end of the wing closest to the fuselage

Rudder

- control surface that can turn the nose of the airplane to the left and the right

S

Sandwich

- a panel which has a great stiffness by spatial shape, build up of a core material with two face sheets

Servo actuator

- independent power driven adjustment or shifting mechanism

Shear / shearforce

- a form of loading which tends to cause the atoms or molecules of a material to slide over each other, similar to the action created by a pair of scissors

Sheet

- flat piece of material with thickness under 6 mm (see also plate)

Shell structure

- structure which is build up of load bearing, thin sheet material, with stiffening elements

Shock wave

- an area of rapid change of air pressure created when air flows at a higher speed than the local speed of sound

Skin

- the sheets on the outside of the structure

Slat

- a control surface at the leading edge of the wing that increases wing surface area and lift when extended

Slot

- opening or gap in the structure

Smart structure

- structures that are able to sense changes in their environment and then respond to these changes in predetermined manner

Span

- the distance from wing-tip to wing-tip

Spar

- a spanwise beam in a wing which carries the majority of bending moment generated by lift, weight and inertia loads

Spar cap

- upper and lower part of the spar separated by a web. The bending moment in the wing is transferred via shear in the web into tension and compression forces in the caps

Speedbrake

- control surface to slow down the airplane

Splice

- joint made in assembly of aircraft components (over a manufacturing division), in which all individual parts have to be connected

Spoiler

- opening panels on upper surface of the wing to disturb the airflow over the wing (spoils lift), sometimes used to supply additional roll control

Stabilizer

- to give the aircraft stability during flight, smaller wing (fixed horizontal and vertical) are located at the tail of the plane

Stalling speed

- the lowest speed of the aircraft in flight at which the airflow over the wing separates and becomes turbulent, so the lift will be lost

Station line

- measuring line or plane giving frame position

Stiffness

- the measure of the resistance against deformation or displacement, material property (see modulus) but also structural characteristic

Strain

- the elongation divided by the original length

Strap

- strip of material used to join parts together

Strength-to-weight ratio

- the ratio of the material's static strength to its weight, also called specific strength

Stress

- the intensity of loading, given by the applied force divided by the area over which the force acts

Stringer

- a stiffening member which supports a section of the load carrying skin, to prevent buckling under compression or shear loads

Structure

- the way several parts are connected together to fulfill a load carrying function

Strut

- a slender (bar or tubular) structural member which is loaded in compression

Stub

- short stump, structure to attach engine to fuselage

Sweep angle

- the angle between quart chord line of the wing and centre line of fuselage, swept-back has a positive sweep angle

T

Tail unit

- aft section of the fuselage onto which the tailplanes are attached

Taileron

- an aileron in the tail

Tailplane

- the vertical or horizontal planes at the back of the fuselage

Tension

- effect produced by two forces pulling against each other

Thrust

- the force generated by the engine(s) making an aircraft to travel forwards, overcoming the drag force

Thrust reverser

- system of flaps or doors on the jet engine that bends the jet forward, thus slowing down the aircraft after landing

Tie

- a tension loaded part used to attach system parts

Tip

- the outermost extremity of a wing

Torsion

- moment in the cross-section

Torsion box

- combined spars and skin that create a closed box in the wing to take torsion forces

Trailing edge

- the back of the wing or tailplane structure

Trim

- balanced condition, an airplane that is flying at an angle of attack such that its moment about the centre of gravity is zero

Truss

- structure which it's made out of tubes, rods or thin elements, each element only loaded in tension or compression

Tube

- a pipe which can take torsion, or used as strut

Turbine

- a part of the engine which extracts kinetic energy from the expanding gases coming from the combustion chamber, using this to drive the compressor

Turbulence

- gust of wind

U

Ultimate load

- the load which will cause failure of the structure

Undercarriage

- the system on which the airplane can land or descent (also called landing gear)

W

Web

- a structural member mainly loaded in shear in the plane of the member (part of the spar, and sometimes in ribs and frames)

Weight

- the mass multiplied by the gravitation

Welding

- a way of jointing two parts together by local melting

Window

- a cut-out in the structure, covered with a transparent material to look through

Windscreen, windshield

- the front window

Wing

- the plane to provide lift

Wing box

- a box in the wing to take torsion forces

Wing loading

- an aircraft's weight (or effective weight if it manoeuvring) divided by its gross wing area

Wing span

- the distance from wing-tip to wing-tip

Winglet

- the vertical aerodynamic plane at the end of the wings

Wire-braced structure

- a structure that is held together by wires

Work hardening

- the increase in hardness and strength of a ductile metal as it is plastically deformed below its recrystallization temperature

Y

Yield point

- stress level of a loaded material where next to deformation starts to become plastic